Towards an active and happy retirement? Changes in leisure activity and depressive symptoms during the retirement transition

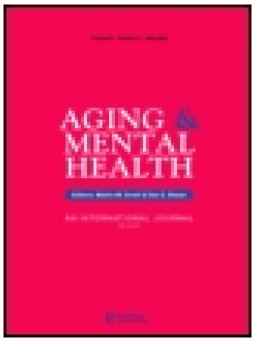
Citation for published version:
Henning, G, Stenling, A, Bielak, AAM, Bjälkebring, P, Gow, AJ, Kivi, M, Muniz-terrera, G, Johansson, B & Lindwall, M 2020, 'Towards an active and happy retirement? Changes in leisure activity and depressive symptoms during the retirement transition', *Aging and Mental Health*, pp. 1-11. https://doi.org/10.1080/13607863.2019.1709156

Digital Object Identifier (DOI):
10.1080/13607863.2019.1709156

Link:
Link to publication record in Edinburgh Research Explorer

Document Version:
Publisher's PDF, also known as Version of record

Published In:
Aging and Mental Health



Aging & Mental Health

ISSN: 1360-7863 (Print) 1364-6915 (Online) Journal homepage: https://www.tandfonline.com/loi/camh20

Towards an active and happy retirement? Changes in leisure activity and depressive symptoms during the retirement transition

Georg Henning, Andreas Stenling, Allison A.M. Bielak, Pär Bjälkebring, Alan J. Gow, Marie Kivi, Graciela Muniz-Terrera, Boo Johansson & Magnus Lindwall

AGING & MENTAL HEALTH
https://doi.org/10.1080/13607863.2019.1709156

Towards an active and happy retirement? Changes in leisure activity and depressive symptoms during the retirement transition

Georg Henning[a,b], Andreas Stenling[c,d], Allison A.M. Bielak[e], Pär Bjälkebring[b,f], Alan J. Gow[g], Marie Kivi[b], Graciela Muniz-Terrera[h], Boo Johansson[b] and Magnus Lindwall[b,i]

[a]German Centre of Gerontology, Berlin, Germany; [b]Department of Psychology, & AgeCap, University of Gothenburg, Gothenburg, Sweden; [c]Department of Psychology, University of Umeå, Umeå, Sweden; [d]Department of Psychology, University of Otago, Dunedin, New Zealand; [e]Department of Human Development and Family Studies, Colorado State University, Fort Collins, USA; [f]Department of Psychology, The Ohio State University, Columbus, OH, USA; [g]Department of Psychology, Heriot-Watt University, Edinburgh, UK; [h]Centre for Dementia Prevention, University of Edinburgh, Edinburgh, UK; [i]The Swedish School of Sport and Health Sciences, Stockholm, Sweden

ABSTRACT

Objectives: Retirement is a major life transition in the second half of life, and it can be associated with changes in leisure activity engagement. Although theories of retirement adjustment have emphasized the need to find meaningful activities in retirement, little is known about the nature of changes in leisure activity during the retirement transition and their association with mental health.
Methods: Based on four annual waves of the 'Health, Aging and Retirement Transitions in Sweden' study, we investigated the longitudinal association of leisure activity engagement and depressive symptoms using bivariate dual change score models. We distinguished intellectual, social, and physical activity engagement.
Results: We found increases in all three domains of activity engagement after retirement. Although level and change of activity and depressive symptoms were negatively associated, the coupling parameters were not significant, thus the direction of effects remains unclear.
Conclusion: The results highlight the need to consider the role of lifestyle changes for retirement adjustment and mental health.

ARTICLE HISTORY
Received 13 June 2019
Accepted 16 December 2019

KEYWORDS
Leisure activity; retirement adjustment; depressive symptoms

Introduction

An active lifestyle is often seen as a key factor for successful aging (Rowe & Kahn, 1997). Particularly in older age, leisure activity engagement is a central part of an active lifestyle. In the present paper, we apply a broad and inclusive, so-called residual (Kuykendall, Boemerman, & Zhu, 2018; Roberts, 1999) or structural (Kuykendall, Tay, & Ng, 2015) definition of leisure activities as non-work related and non-obligatory activities that people engage in during their free time. Among older adults, leisure activity engagement is associated with higher well-being and better mental health (Lampinen, Heikkinen, Kauppinen, & Heikkinen, 2006; Silverstein & Parker, 2002), as well as with better physical and cognitive health (Bielak, Gerstorf, Anstey, & Luszcz, 2014; Chang, Wray, Lin, 2014; Köhncke et al., 2016; Lee, Chi, & Palinkas, 2019). The positive effects of leisure activity engagement seem to increase with age (Nimrod & Shrira, 2016), and are stronger in retirees than in workers (Kuykendall et al., 2015). Although leisure activity is associated with various health outcomes, we still know little about changes in leisure activity across significant life events such as the retirement transition, and how such changes in activity are related to mental health and adjustment.

Changes in leisure activity after retirement

In older age, a shift from outdoor and active to indoor and passive leisure takes place (Nimrod & Janke, 2012). Engagement in leisure activities in later life is usually a continuation of leisure activity engagement earlier in life (Agahi, Ahacic, & Parker, 2006; Nimrod & Janke, 2012), and tends to decrease in old age, when health declines set in (Janke, Davey, & Kleiber, 2006; Wetzel & Huxhold, 2016). However, there are considerable inter-individual differences in these changes (Janke et al., 2006; Strain, Grabusic, Searle, & Dunn, 2002).

Even though most people maintain a similar pattern of leisure activity engagement into later life, changes may happen in specific periods, such as the transition to retirement. After retirement, individuals usually have considerably more free time available than before, which can be used according to their own preferences. Continuity theory (Atchley, 1971) implies that people strive for continuity in most important aspects of their life. Leisure activity can help to maintain some aspects from their pre-retirement life by providing for example self-respect (Atchley, 1971), cognitive stimulation (Andel, Finkel, & Pedersen, 2016), and social contacts (Huxhold, Fiori, & Windsor, 2013). The retirement transition is thus a period in which older adults can potentially increase their engagement in leisure activities and an increased level might be important for late-life health, as people are less likely to start new activities later on (Nimrod & Janke, 2012).

Measures of leisure activity during the retirement transition have differed between previous studies. Unclear and changing definitions and measurement of leisure activity

CONTACT Georg Henning georg.henning@dza.de

engagement have been seen as a major problem in research on leisure activity and well-being in older adults (Adams, Leibbrandt, & Moon, 2011). In the present paper, we distinguish physical, social, and intellectual activities, which is common in the cognitive aging literature (see e.g. Fratiglioni, Paillard-Borg, & Winblad, 2004; Lam et al., 2015; Sposito, Neri, Yassuda, 2015; Wang, Xu, & Pei, 2012). These separate categories have been found to predict outcomes in different ways (Lam et al., 2015; Wang, Xu, & Pei, 2012) and also highlight potential pathways for benefits: Social activities may provide social support, in particular in times of distress (Iso-Ahola & Park, 1996), and feelings of relatedness and belonging (Kuykendall et al., 2018). Both social support and feelings of relatedness are important predictors of well-being in the retirement transition (Hansson, Buratti, Thorvaldsson, Johansson, & Berg, 2017; Henning, Bjälkebring, et al., 2019). Social leisure activity has been related to better well-being and mental health in older adults (Glass, Mendes de Leon, Bassuk, & Berkman, 2006; Hong, Hasche, & Bowland, 2009; Min, Ailshire, & Crimmins, 2016). Physical leisure activities may buffer stress as well (Harris, Cronkite, & Moos, 2006; Heaney, Carroll, & Phillips, 2014) and consequently promote mental health and well-being in older adults (Netz, Wu, Becker, & Tenenbaum, 2005; Penedo & Dahn, 2005). More specifically, a lower level of overall physical activity after retirement has been associated with increased depressive symptoms across the retirement transition (Dave, Rashad, & Spasojevic, 2008). Intellectual activities may mainly provide distraction and mental stimulation and are associated with better cognitive health in older adults (Lam et al., 2015), but have rarely been investigated as a correlate of well-being and mental health.

Most studies on changes in leisure activity after retirement have focused on physical leisure activity engagement (e.g. Berger, Der, Mutrie, & Hannah, 2005; Godfrey et al., 2006; Lahti, Laaksonen, Lahelma, & Rahkonen, 2011; Slingerland et al., 2007). Authors of a systematic review concluded that the total physical activity from leisure activities seems to increase during the transition to retirement (Barnett, van Sluijs, & Ogilvie, 2012), but only among people with higher socioeconomic status. With regard to leisure activity in general, previous studies showed mixed results, finding increases, decreases or stability in activity level (Earl, Gerrans, & Halim, 2015; Nimrod, 2007; Nimrod, Janke, & Kleiber, 2008; Rosenkoetter, Gams, & Engdahl, 2001; Scherger, Nazroo, & Higgs, 2011; Wetzel, Bowen, & Huxhold, 2019). Studies were often based on retrospective self-reports (Earl et al., 2015; Nimrod, 2007; Rosenkoetter et al., 2001) or compared only two time points (Nimrod et al., 2008; Scherger et al., 2011; Wetzel et al., 2019). Taken together, results on the development of leisure activity engagement across the retirement transition are equivocal.

Leisure activity and mental health in retirement

A higher level of leisure activity is associated with better well-being and mental health, in particular among those retired (Kuykendall et al., 2015). The retirement transition may be a time period in which leisure activity is particularly beneficial. Van Solinge and Henkens (2008) argued that coping with the loss of the work role and establishing a satisfying post-retirement lifestyle are the main tasks when entering retirement. Regarding the loss of the work role, leisure activity can offer alternative roles outside the work place to focus on, which should ease adjustment (Ryser & Wernli, 2017). Working has a number of important functions for the individual, such as providing identity, structure, social stimulation, collective purpose, and activity (Paul & Batinic, 2010), and when people retire, they need to find other activities to replace it. Leisure activity can help to replace work in this respect and facilitate continuity in retirement (Atchley, 1971). Likewise, the resource-based dynamic perspective on retirement adjustment postulates that change in retirement adjustment is a result of changes in social, emotional, financial, physical, cognitive, and motivational resources (Wang, Henkens, & van Solinge, 2011). Leisure activity in retirement may offer replacement for some of these resources (e.g. cognitive, physical, and social) previously provided at work.

Hence, it is possible that those more active in leisure activities before retirement may find it easier to withdraw from the work role, as alternative roles already exist. Further, increases in leisure activity may help preventing resource losses and achieve continuity. Therefore, both a higher level of pre-retirement engagement in leisure activities, as well as increases across the transition may have a positive impact on post-retirement mental health and adjustment.

Few studies have addressed the role of leisure activity in the retirement adjustment process. In a longitudinal multilevel model, Ryser and Wernli (2017) did not find that participation in clubs or group activities predicted affect in the retirement transition. Likewise, Van Solinge and Henkens (2005) did not find a significant association between number of pre-retirement hobbies and post-retirement perceived adjustment, but they did not look at changes in adjustment or activity. Retrospective studies show a positive association between increased activity engagement in retirement and post-retirement well-being (Earl et al., 2015; Nimrod, 2007). Nevertheless, the direction of causality remains unclear. Depressive symptoms often include inactivity and a lack of motivation, and go hand in hand with maladaptive health behaviors, which may limit activity as well (Lindwall, Larsman, & Hagger, 2011). Such reasoning is supported by research in a sample of widowed women, showing that the effect of depressive symptoms on leisure activity reduction was stronger than the effect of activity reduction on depressive symptoms (Janke, Nimrod, & Kleiber, 2008). Physical activity in particular seems to have a reciprocal relation with depression in older adults (e.g. Azevedo da Silva et al., 2012; Gudmundsson et al., 2015; Lindwall et al., 2011). Thus, longitudinal analyses are required to understand if leisure activity promotes well-being and mental health in retirement, or if those with better mental health are more likely and able to be active. For instance, before interventions to promote psychological health in retirement, based on increased leisure activity, can be planned, we need to understand if a potential association of mental health and leisure activity is driven by parallel changes, if lower mental health leads to inactivity, or if leisure activity can predict changes in mental health. However, we are not aware of studies investigating the bidirectional relationship between leisure activity and mental health across the transition to retirement.

The present study

In the present study, we investigated the longitudinal association of leisure activity and depressive symptoms in the first three years of retirement in $n = 1{,}033$ retirees. Analyses were based on the Swedish Health, Aging and Retirement Transitions in Sweden (HEARTS) study.

Given the potentially reciprocal association of activity and depression, we used a bivariate dual change score model (BDCSM; McArdle & Hamagami, 2001 ; McArdle, 2009). This model enables to test the direction of the relation between leisure activity and depressive symptoms. The model is explained more in detail in the method section. We expected bidirectional effects, therefore our hypotheses were:

> H1: Higher leisure activity engagement predicts decreases in depressive symptoms.

> H2: More depressive symptoms predict decreases in leisure activity engagement.

Method

Participants

Our analyses were based on four waves of data from the Swedish HEARTS study. HEARTS is a longitudinal study with annual measurements. Currently, four waves of data are available. The survey is conducted online, with a paper version available upon request. Of a nationally representative sample of people between 60–66 years of age at baseline ($N = 14{,}990$), 5,913 individuals participated in the first assessment in 2015. In 2016, 4,651 people participated in wave 2, 4,320 in wave 3 in 2017, and 4,033 in wave 4 in 2018. For more information on the sample and the assessed information, see Lindwall et al. (2017).

In Sweden, state-based pensions can be taken out from age 61 on, and people cannot be dismissed from their employment for age reasons until age 67. The present analyses included people who were working at baseline and retired over the study period. People who considered themselves as workers at later waves were excluded. Furthermore, for people with indirect transitions (e.g. from unemployment) the retirement transition might have been when they left work, therefore we excluded participants who were unemployed, on sick leave, or received sickness benefits at any time point during the study. The final sample comprised 1,124 persons. Of these, 424 retired between waves 1 and 2, 367 between waves 2 and 3, and 333 between waves 3 and 4. Because of missing data on covariates, only 1,033 participants were included in the main analyses.

Table 1 shows baseline descriptive statistics of the study variables.

As we focused on the retirement transition as a longitudinal process, we re-centered the data around the retirement transition and included data from the wave before retirement until up to three waves afterwards. We included all retirees for whom we had data on the retirement status one wave before and one wave after retirement. Consequently, those who retired between the first two waves could contribute up to four waves, those who retired between wave 2 and 3 contributed up to three waves, and those who retired between wave 3 and 4 contributed two waves of data.

Table 1. Descriptive statistics.

	M (SD) / %
Age at baseline	63.34 (1.64)
Age at retirement	64.26 (1.56)
Gender (% female)	56.81%
Tertiary education	53.48%
Average number of symptoms and diseases (pre-retirement)	3.55 (2.63)
Work satisfaction (pre-retirement, 1–7)*	5.75 (1.22)
Physical work demands (pre-retirement, 1–5)**	2.19 (1.39)
Working in retirement	29.42%
Control over timing of Retirement (1–5)***	4.62 (0.96)
Intellectual activity engagement (pre-retirement, 0–20)	14.14 (3.53)
Social activity engagement (pre-retirement, 0–40)	10.28 (3.42)
Physical activity engagement (pre-retirement, 0–40)	9.77 (3.86)
Depressive symptoms (pre-retirement, 0–3)	0.55 (0.36)

$n = 1{,}124$. * 7 = very satisfied ** 5 = completely correct *** 5 = 100% control. *Note.* The sample statistics include all individuals that were working at one wave and retired at the next. The n per cell varied from 1,083 – 1,124.

Measures

Activity

Leisure activity engagement was assessed with a list of 27 activities. Frequency of participation in each activity was provided on a scale from 1 (never or almost never) to 6 (everyday). We recoded this scale to 0–5. We excluded the following 4 items: (1) 'spending time at one's boat or summerhouse' was unclear as to what kind of activities were pursued there; (2) 'volunteering' was unspecific and volunteering and other prosocial behaviors are different from other leisure activities as they elicit both strong negative and positive emotions (Bjälkebring, Västfjäll, Dickert, & Slovic, 2016); (3) 'assisting relatives' was not considered a leisure activity; and (4) 'skiing/cycling' was not consistently assessed between waves.

As mentioned above, activities are often divided into pre-dominantly social, intellectual, and physical leisure activities (e.g. Lam et al., 2015), and they may contribute to mental health in different ways. We followed this differentiation in the present study. To better capture the qualitative differences between the activities, five independent raters with expertise on aging research and/or leisure activities, but without involvement in the present manuscript, rated each activity as representing one of four categories (i.e. intellectual, social, and cognitive, and 'no category applies'). The inter-rater reliability (Fleiss' Kappa, Fleiss, 1971) was high and significant (κ=.71, $p < .001$) reflecting substantial agreement among the raters (see Appendix A). Two activities were rated as 'no category' by more than one rater, namely 'hobbies such as crochet, sewing, carpentry, painting, collecting stamps etc.' (two raters rated as no category) and watching sport in the stadium (three raters rated as no category). One item was rated as social by two raters, intellectual by two raters, and not possible to categorize by the fifth (playing board games, card games, bingo, bridge etc.), so we excluded it as well. Fifteen items were categorized univocally. For the remaining five items, we chose the category for which the majority had voted. Instructions for raters and the results of the coding can be found in the Appendix A. Table 2 shows the activities defined as pre-dominantly physical, social, or intellectual.

Our main outcomes were sum scores for all three domains. Higher scores represent a higher level of activity frequency. Our resulting factors correlated positively, but only weakly, indicating that they represent different concepts. Correlations are presented in Table 3.

Authors of some previous studies have based their leisure activity scores on factor analysis (e.g. Gow, Pattie, & Deary, 2017); however, there are particular problems with applying the logic of factor analysis to the measures of leisure activity in the present study. Techniques such as confirmatory factor analysis (CFA) or exploratory factor analysis (EFA) assume one or several latent activity factors that underlie participation in different leisure activities, and they are based on close statistical associations between similar activities. Hence, it is assumed that engagement in one activity is related to engagement in other similar activities. However, because daily time for activities is restricted, engaging in one activity can also make it less likely to participate in another activity. This is in contrast to applying CFA or EFA to responses from a psychological self-report scale in which people's response to one item of a domain is expected to (and usually tends to) be related to their responses to other items in that domain. Furthermore, the present differentiation has a higher face validity and is often easier to interpret than results from CFA or EFA (Nimrod & Janke, 2012).

Retirement status

Retirement status was assessed with a single item at all waves: 'Are you retired (i.e. have started to receive old age pension)?'. Response options included 1 'No', 2 'Yes - but continue working and do not perceive myself as a pensioner', 3 'Yes - continue working but perceive myself as a pensioner', or 4 'Yes, full-time retired'. In the present study, we defined those as retired who perceived themselves as retired (categories 3 and 4). Those who reported that they felt as retirees, but still worked, were coded as working in retirement, which was included as a covariate.

Table 2. Leisure activities.

Intellectual activities	Social activities	Physical activities
Reading books	Cultural activities	Gardening
Reading newspapers	Religious activities	Outdoor activities
Using the computer	Eating out	Walking
Crosswords	Visiting relatives	Dancing
	Being visited by relatives	Golf
	Visiting friends	Boule
	Being visited by friends	Ball games
	Study groups	Exercise

Depressive symptoms

Depressive symptoms were assessed using the 8-item short form of the CES-D scale (Van de Velde, Levecque, & Bracke, 2009). Participants were asked how often they had experienced each of the symptoms during the last week, with the response options 0 'Rarely/never (less than 1 day)', 1 '1–2 days', 2 '3–4 days', and 3 'Most/all of the time (5–7 days)'. Cronbach's alpha was 0.80 for all time points. The 8-item CES-D showed strong measurement invariance (i.e. invariance of factor loadings and intercepts) across the four time points; however, because of the complexity of the bivariate dual change score models and consequent problems of model fit and convergence, we used manifest mean scores in the change score models.

Covariates

We controlled for the effects of sociodemographic differences (age at retirement, gender and education), as well as the effects of basic financial resources, work in retirement, control over retirement, and disease load. Pre-retirement basic financial resources, a lack of control over retirement, as well as a worse health status may affect both post-retirement mental health (Henning et al., 2016) and the opportunity to engage in leisure activity, without a causal link between the two variables. Likewise, post-retirement work may also limit the hours to engage in leisure activity and at the same time be associated with better or worse mental health, depending on the underlying work motivation (Henning, Stenling, et al., 2019).

Information about age, gender, and education were taken from the first wave. We differentiated between highly educated individuals (at least some tertiary education) and others. Disease load was taken from the last survey before retirement. The measure was based on a list of 33 possible symptoms and diseases. To prevent an overlap with the depression scale, we excluded mental health symptoms and only included 27 physical symptoms/diseases. Financial resources were not assessed with the same item at all time points, hence, baseline financial resources were used as a proxy for general financial problems. Participants were asked if they could cover unpredicted costs of 15,000 SEK (~ €1,500) by means of their own household, with help from others, or not at all. Those who could afford it by their own means were coded as having basic financial resources (coded 1/0). Control over retirement was assessed with one item phrased 'Was it your decision to retire, or did you feel forced to do so (e.g. by health or organizational reasons etc.)?'. Response categories were 1

Table 3. Correlations of the three activity factors.

	1	2	3	4	5	6	7	8	9	10	11	12
1. I.A. (last assessment before retirement)	1											
2. S.A. (last assessment before retirement)	.21***	1										
3. P.A. (last assessment before retirement)	.21***	.26***	*1*									
4. I.A. (first assessment in retirement)	.81***	.16***	.17***	*1*								
5. S.A. (first assessment in retirement)	.23***	.68***	.21***	.25***	*1*							
6. P.A. (first assessment in retirement)	.17***	.21***	.72***	.18***	.22***	*1*						
7. I.A. (second assessment in retirement)	.76***	.09*	.15***	.81***	.20***	.13**	*1*					
8. S.A. (second assessment in retirement)	.16***	.62***	.16***	.17***	.70***	.18**	.24***	*1*				
9. P.A. (second assessment in retirement)	.14***	.18***	.67***	.12***	.18***	.74**	.18***	.21***	*1*			
10. I.A. (third assessment in retirement)	.72***	.19**	.23***	.79***	.20***	.23**	.81***	.23***	.25***	*1*		
11. S.A. (third assessment in retirement)	.20***	.58***	.20***	.18**	.65***	.26**	.26***	.71***	.23***	.26***	*1*	
12. P.A. (third assessment in retirement)	.10	.24***	.70***	.13*	.21***	.77**	.21***	.23***	.78***	.26***	.27***	*1*

$n = 322$–1,033, depending on the time point. *Note.* I.A.=Intellectual Activity, S.A.= Social Activity, P.A. = Physical activity.
*$p < .05$, ** $p < .01$, ***$p < .001$.

'It was my decision (100% my choice)', 2 'It was mostly my decision (∼75% my choice)', 3 'It was partly my decision (∼50% my choice)', 4 'It was my decision to a small extent (∼25% my choice)', and 5 'It was not my decision, I was forced (0% my choice)'. We reversed the coding so higher scores indicated more control.

Analysis

All analyses were performed using Mplus 7.4 (Muthén & Muthén, 2015). Missing data was handled using the full-information maximum likelihood estimator. Model fit was investigated with a combination of different fit indices – the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). A CFI greater than 0.90 and 0.95 typically reflects acceptable and excellent fit to the data, respectively. RMSEA and SRMR values less than 0.08 and 0.05 are usually seen as a reasonable and close fit to the data, respectively (Marsh, 2007; Marsh et al., 2010). The alpha level for all analyses was set to 5%.

We estimated three separate bivariate dual change score models (BDCSM; McArdle & Hamagami, 2001; McArdle, 2009) to assess associations between depressive symptoms and intellectual, social, and physical leisure activity engagement, respectively. The model is illustrated in Figure 1 and the setup was the same for all three analyses. The letter D refers to depressive symptoms, whereas the letter A refers to activity engagement. For both variables, the model includes an intercept, which relates to the baseline level (I_D/I_A in the figure), and a linear slope (S_D/S_A), as well as a proportional change parameter to model complex nonlinear change (β_D/β_A).

The advantage of the BDCSM, compared to other models such as latent growth curves, are the coupling parameters (γ_{DA}/γ_{AD}), showing if the level of one variable at a specific time point [t] predicts subsequent changes until the next measurement point in the other variable [$\Delta(t, t+1)$] (and vice versa), over and above the general slope-slope association (Bainter & Howard, 2016; Schöllgen, Huxhold, & Schmiedek, 2012; Wetzel & Huxhold, 2016). This part of the model allows a better understanding of the directionality of effects and is the parameter of main interest.

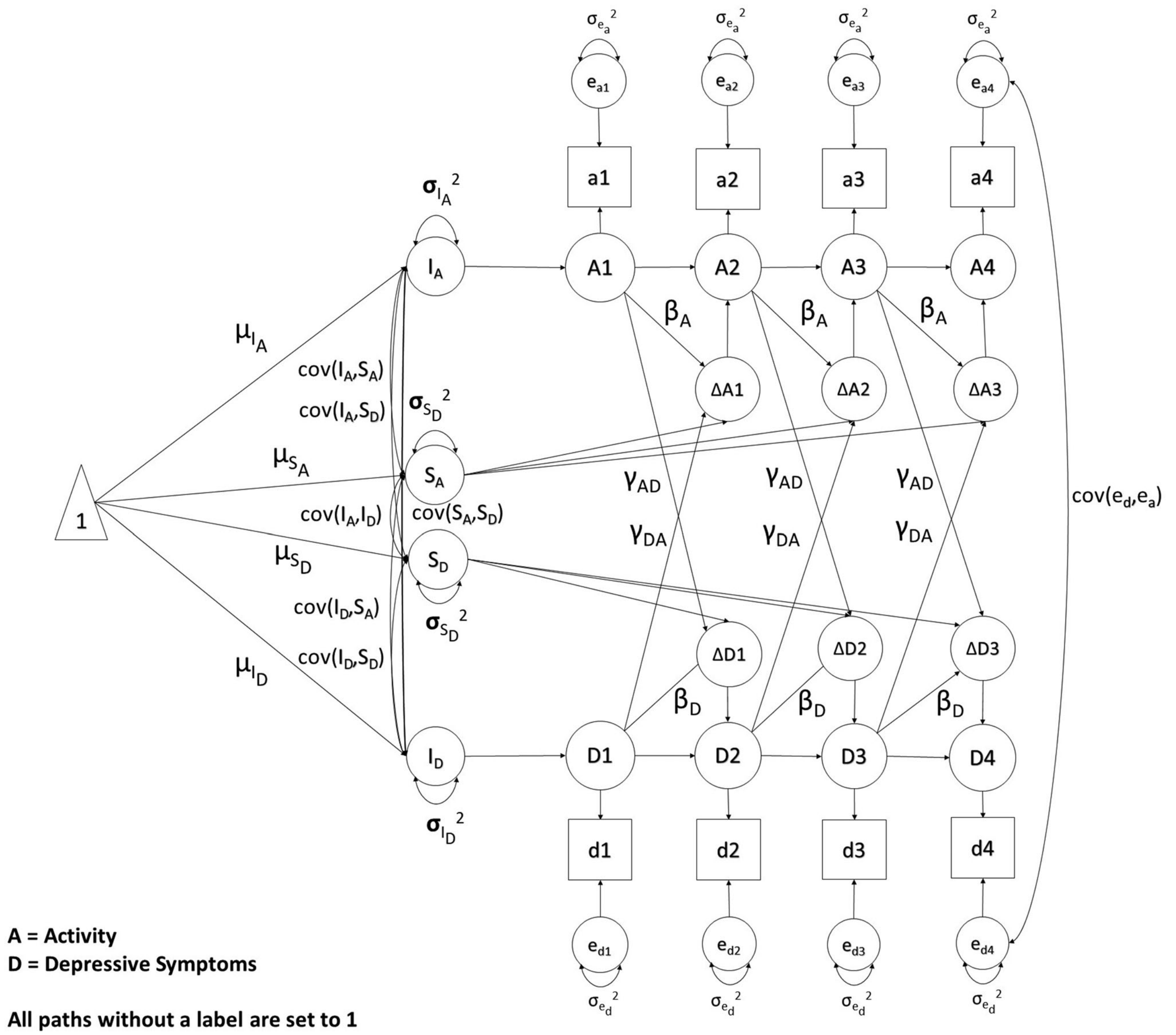


Figure 1. Bivariate dual change score model.

Further bivariate parameters include the covariance of the intercepts (i.e. associations between pre-retirement activity level and depressive symptoms, *cov*(I_D/I_A)), slope-slope associations (associations between linear change in both variables, *cov*(S_D/S_A)), and intercept-slope associations (i.e. associations between the pre-retirement level of one variable and linear change across time, *cov*(I_D/S_A) and *cov*(I_A/S_D)). However, these parameters are more complex to interpret than in latent growth curves and thus are commonly interpreted with caution (Grimm, 2007). Residuals were correlated (cov(ed/ea).Error variances and coupling parameters were estimated equal across time points. The control variables were integrated as predictors of the intercept and slope factors of both variables in the BDCSM.

Following recommendations in the literature (McArdle & Grimm, 2010), we used model tests to compare nested models based on χ^2 values. The baseline model was a model with both couplings (γ_{DA}/γ_{AD}) estimated, further models included either only the γ_{DA} or the γ_{AD} coupling parameters, to test directionality, or no couplings. If setting one or more parameters to 0 did not affect the model fit significantly, a more restricted model was chosen. This approach helps to understand which variable has a stronger effect on the other.

Results

Trajectories of leisure activity engagement across retirement

Figure 2 shows the trajectories of depressive symptoms. Figure 3 shows the trajectory of intellectual, social and physical leisure engagement, standardized for a better comparability. The graphs are derived from univariate change score models (see Table 4).

Whereas depressive symptoms seemed to decline slightly directly after the retirement event, followed by stability, engagement in the three activity domains seemed to show the opposite pattern, with initial increases and stability later on.

Longitudinal associations of leisure activity engagement and depressive symptoms

We computed three bivariate dual change score models with covariates (age, gender, education, disease load, financial resources, post-retirement work, control over retirement) as predictors of the intercepts and slopes.

We compared models with both coupling parameters, only depressive symptoms predicting activity, only activity

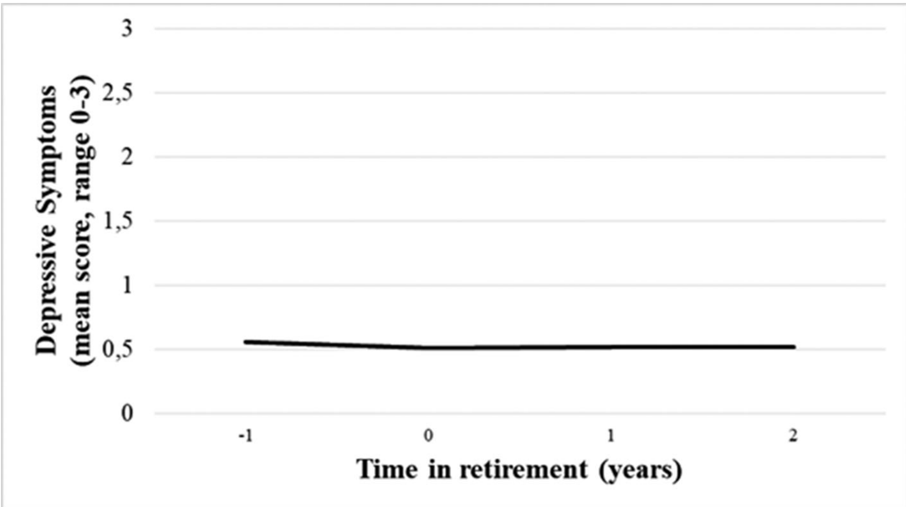


Figure 2. Change in depressive symptoms.

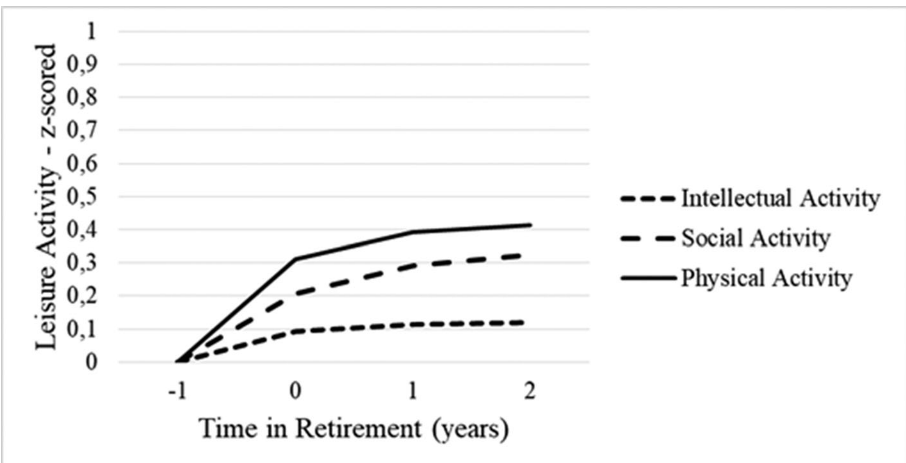


Figure 3. Changes in leisure activity engagement across retirement.

Table 4. Univariate dual change score models.

Parameter	Depressive Symptoms B (SE)	Intellectual Activity Engagement B (SE)	Social Activity Engagement B (SE)	Physical Activity Engagement B (SE)
Intercept	0.55 (0.01)***	14.12 (0.12)***	10.28 (0.10)***	9.76 (0.12)***
Linear slope	0.62 (0.10)***	11.13 (0.67)***	6.63 (1.13)***	8.22 (0.74)***
Proportional change	−1.20 (0.18)***	−0.77 (0.05)***	−0.59 (0.11)***	−0.74 (0.07)***
Variance intercept	0.09 (0.01)***	12.46 (0.53)***	8.18 (0.51)***	11.33 (0.65)***
Variance slope	0.10 (0.03)**	6.04 (0.77)***	3.50 (1.10)**	6.43 (1.21)***

Model Fit: Depressive Symptoms: CFI = 0.975, SRMR = 0.067, RMSEA = 0.056, 90% CI [0.037, 0.076]. Intellectual Activity: CFI = 0.997, SRMR = 0.067, RMSEA = 0.028, 90% CI [0.000, 0.051]. Social Activity: CFI = 0.997, SRMR = 0.027, RMSEA = 0.025, 90% CI [0.000, 0.049]. Physical Activity: CFI = 1.000, SRMR = 0.010, RMSEA = 0.000, 90% CI [0.000, 0.032]. ***p < .001.

Table 5. Model fit of the three bivariate dual change score models.

	Intellectual activity		Social activity		Physical activity	
	χ^2 (df)	$\Delta\chi^2$ (df)	χ^2 (df)	$\Delta\chi^2$ (df)	χ^2 (df)	$\Delta\chi^2$ (df)
Full coupling	101.27 (51)		72.65 (51)		81.22 (51)	
γ_{DA} free	101.27 (52)	0.00 (1)	72.66 (52)	0.00 (1)	83.19 (52)	1.96 (1)
γ_{AD} free	104.34 (52)	3.07 (1)	76.28 (52)	3.63 (1)	82.34 (52)	1.12 (1)
No couplings	104.59 (53)	3.32 (2)	76.45 (53)	3.80 (2)	84.39 (53)	3.16 (2)

Table 6. Bivariate dual change score models.

	Model 1: Intellectual activity		Model 2: Social activity		Model 3: Physical activity	
	Depressive symptoms *B (SE)*	Intellectual activity *B (SE)*	Depressive symptoms *B (SE)*	Social activity *B (SE)*	Depressive symptoms *B (SE)*	Physical activity *B (SE)*
Intercept baseline level	0.48 (0.48)	3.92 (4.53)	0.49 (0.48)	9.52 (4.54)*	0.50 (0.48)	13.42 (5.13)**
Intercept linear slope	0.63 (0.52)	1.09 (2.49)	0.62 (0.52)	2.11 (3.15)	0.59 (0.50)	8.03 (4.23)*
Proportional change	−1.32 (0.17)***	-0.49 (0.13)**	−1.32 (0.16)***	−0.61 (0.10)***	−1.28 (0.15)***	−0.82 (0.07)***
Univariate covariance intercept − slope	0.08 (0.01)***	3.81 (1.10)**	0.08 (0.01)***	4.28 (0.82)***	0.08 (0.01)***	7.69 (0.85)***
Residual variance level	0.07 (0.01)***	8.97 (0.49)***	0.08 (0.01)***	7.50 (0.51)***	0.08 (0.01)***	10.36 (0.64)***
Residual variance slope	0.10 (0.03)***	2.18 (1.01)*	0.10 (0.03)***	3.27 (0.98)**	0.10 (0.02)***	7.22 (1.24)***
Bivariate associations						
Covariance intercept activity − intercept depressive Symptoms	−0.06 (0.04)		−0.14 (0.04)***		0.00 (0.04)	
Covariance intercept activity − slope depressive Symptoms	−0.08 (0.04)		−0.19 (0.05)***		−0.10 (0.04)*	
Covariance intercept depressive symptoms −slope Activity	−0.02 (0.02)		−0.10 (0.03)**		−0.04 (0.03)	
Covariance slope depressive symptoms − slope activity	−0.02 (0.02)		−0.10 (0.04)***		−0.06 (0.04)	
Correlation of residuals	−0.02 (0.01)*		−0.03 (0.01)**		−0.06 (0.01)***	
Depressive symptoms ➔ change in activity	@0		@0		@0	
Activity ➔ change in depressive symptoms	@0		@0		@0	

N = 1,033. *Note.* Unstandardized parameters. Effects of covariates on intercepts and slopes are included in the model, but not displayed. Model fit: Intellectual activity: CFI = 0.985, SRMR = 0.031, RMSEA = 0.031, 90% CI [0.022, 0.039]. Social activity: CFI = 0.991, SRMR = 0.028, RMSEA = 0.021, 90% CI [0.009, 0.030]. Physical activity: CFI = 0.989, SRMR = 0.025, RMSEA = 0.024, 90% CI [0.014, 0.033]. *$p < .05$ ** $p < .01$ ***$p < .001$.

predicting depressive symptoms, and no coupling parameters. The fit for these models can be found in Table 5. For all three types of leisure activity, setting one or both coupling parameters to 0 did not decrease model fit significantly. Thus, the final models were those without estimated coupling parameters. Consequently, our results did not suggest that activity predicts depressive symptoms or vice versa, in contrast to our initial hypotheses.

However, the other bivariate parameters showed negative associations of activity and depression: More social activity at baseline was related to fewer depressive symptoms at baseline ($cov(I_D/I_A)$, B = −0.14, SE = 0.04, $p <$ .001), and linear increases in social activity were related to linear decreases in depressive symptoms ($cov(S_A/S_D)$, B = −0.10, SE = 0.03, p = .001).

Higher pre-retirement social (B = −0.19, SE = 0.05, $p <$ .001) and physical (B = −0.10, SE = 0.04, p = .026) activity engagement at baseline were associated with stronger linear decreases in depressive symptoms ($cov(I_A/S_D)$). More depressive symptoms at baseline were related to decreases in social activity ($cov(I_D/S_A)$, B = −0.10, SE = 0.03, p = .001).

Residuals were negatively correlated for intellectual (cov(ed/ea), B = −0.02, SE = 0.01, p = .021), social (B = −0.03, SE = 0.01, p = .006) and physical activity (B = −0.06, SE = 0.01, $p <$ .001).

The final model parameters for the models can be found in Table 6. Covariate effects can be found in appendix B.

Discussion

Leisure activity is believed to be a major source of well-being and mental health in retirement (Atchley, 1971; Kuykendall et al., 2015), but the growing literature on retirement adjustment has often neglected the role of leisure activity engagement in the adjustment process. In the present study, we investigated changes in intellectual, social, and physical leisure activity engagement across the retirement transition, as well as their associations with depressive symptoms.

In our sample, leisure activity engagement increased directly after retirement, but showed relative stability afterwards. This higher level of leisure activity was maintained over the study period. This is encouraging with regard to the well-documented positive effects of leisure activity on health (e.g. Menec, 2003). The small short-term decrease of depressive symptoms after retirement is in line with earlier studies (e.g. Westerlund et al., 2010).

The main motivation behind the present paper concerned the longitudinal associations between leisure activity engagement and depressive symptoms. In line with earlier studies (e.g. Iso-Ahola & Park, 1996; Lindwall et al., 2011), mainly physical and social activity seems to be related to better mental health: People reporting more social activity engagement at baseline reported fewer depressive symptoms and increases in social activities were related to decreases in depressive symptomss. People who were more socially or physically active at baseline showed stronger decreases in depressive symptoms over time. However, higher depressive symptoms at baseline were also associated with linear decreases in social activity engagement. Leisure activity seems to have a negative relationship with mental health, and being active already before retirement may be associated with benefits for retirees.

Nevertheless, the most important parameters, the coupling parameters, did not show that higher social, physical or intellectual activity engagement predicted subsequent decreases in depressive symptoms in the retirement transition. These results are in line with earlier studies (Ryser & Wernli, 2017; Van Solinge & Henkens; 2005) and shed doubt on ideas of leisure activity as the main source of adjustment to a life without work. There may be other activities and roles that are more central for individual adjustment in retirement.

One explanation is that it may not be more activity, but satisfaction with one's leisure activity level (Kuykendall et al., 2015), that contributes to retirement adjustment. Retirees may have different optimal levels of leisure activity and may not always need increases to be satisfied. Higher leisure activity may sometimes even be detrimental to mental health in retirement, as a previous study found that planning too many social activities in retirement was associated with psychological distress in retirement (Yeung, 2013).

Moreover, it should be noted that we investigated change in depressive symptoms, not perceived retirement adjustment (Van Solinge & Henkens, 2005) or subjective well-being (Kuykendall et al., 2015; Ryser & Wernli, 2017). Participants of our study reported a very low level of depressive symptoms, showing a relatively good level of mental health, and there were only very small changes in depressive symptoms over time. Other well-being measures may be more likely to be affected by leisure activity.

Furthermore, in contrast to our expectations, depressive symptoms did not predict decreased activity levels either. Again, this may be mainly because of the low levels of depressive symptoms in our sample.

Strengths and limitations

A strength of the present study is the inclusion of a wide range of activities, and the differentiation of different domains of activity. The large, relatively heterogeneous population-based sample allowed the investigation of inter-individual differences. Furthermore, advanced analyses allowed directional assumptions about the association of leisure activity engagement and depressive symptoms.

One limitation of the current study is the restriction to the years directly around the retirement transition. Neither potential anticipatory lifestyle changes, nor later long-term developments were included in our models. Furthermore, our sample is not completely representative. First, analyses were done in a Swedish sample, and Sweden has a strong welfare state and relatively low poverty in old age (Ebbinghaus & Neugschwender, 2011). Second, the HEARTS sample is comparably healthy and highly educated (Lindwall et al., 2017). It would be interesting to examine if the patterns of change described here replicate in other samples. Third, we deliberately restricted our analyses to direct retirement transitions and did not consider retirement from unemployment (Wetzel, Huxhold, & Tesch-Römer, 2016).

Finally, the effect of leisure activity engagement most likely depends on many inter-individual difference factors. For example, engaging in leisure activity might be more important for mental health if one felt a strong attachment to the former work place, as a form of compensation. Future studies should examine under which conditions leisure activity engagement can contribute to retirement adjustment.

Conclusion

In the present study, we found that engagement in intellectual, social or physical leisure activities increased after retirement. Activity engagement was related to mental health, but the direction of effects was unclear. More research is needed to understand what kind of activities contribute to well-being or mental health, and which factors may moderate these associations.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

Preparation of this manuscript was supported by the grants Dnr 2013-2291 and Dnr 2013-2300 from the Swedish Research Council for Health, Working Life and Welfare (FORTE). Andreas Stenling was supported by an international postdoc grant from the Swedish Research Council (dnr: 2017-00273).

Data availability statement

Because of Swedish data protection laws, we are currently not allowed to share HEARTS data publically. We are working on a solution for this problem.

ORCID

Georg Henning http://orcid.org/0000-0003-2046-1624
Allison A.M. Bielak http://orcid.org/0000-0003-2925-0372
Alan J. Gow http://orcid.org/0000-0002-3320-4531

References

Adams, K., Leibbrandt, S., & Moon, H. (2011). A critical review of the literature on social and leisure activity and wellbeing in later life. *Ageing and Society*, *31*(4), 683–712. doi:10.1017/S0144686X10001091

Agahi, N., Ahacic, K., & Parker, M. G. (2006). Continuity of leisure participation from middle age to old age. *The Journals of Gerontology: Series B*, *61*, 340–346. doi:10.1093/geronb/61.6.S340

Andel, R., Finkel, D., & Pedersen, N. L. (2016). Effects of preretirement work complexity and postretirement leisure activity on cognitive aging. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *71*(5), 849–856. doi:10.1093/geronb/gbv026

Atchley, R. C. (1971). Retirement and leisure participation: Continuity or crisis? *The Gerontologist*, *11*(1 Part 1), 13–17.

Azevedo da Silva, M., Singh-Manoux, A., Brunner, E. J., Kaffashian, S., Shipley, M. J., Kivimäki, M., & Nabi, H. (2012). Bidirectional association between physical activity and symptoms of anxiety and depression: The Whitehall II study. *European Journal of Epidemiology*, *27*, 537–546. doi:10.1007/s10654-012-9692-8

Bainter, S. A., & Howard, A. L. (2016). Comparing within-person effects from multivariate longitudinal models. *Developmental Psychology*, *52*(12), 1955–1968. doi:10.1037/dev0000215

Barnett, I., van Sluijs, E. M., & Ogilvie, D. (2012). Physical activity and transitioning to retirement: A systematic review. *American Journal of Preventive Medicine*, *43*(3), 329–336. doi:10.1016/j.amepre.2012.05.026

Berger, U., Der, G., Mutrie, N., & Hannah, M. (2005). The impact of retirement on physical activity. *Ageing and Society*, *25*(2), 181–195. doi:10.1017/S0144686X04002739

Bielak, A. A. M., Gerstorf, D., Anstey, K. A., & Luszcz, M. A. (2014). Longitudinal associations between activity and cognition vary by age, activity type, and cognitive domain. *Psychology and Aging*, *29*(4), 863–872.

Bjälkebring, P., Västfjäll, D., Dickert, S., & Slovic, P. (2016). Greater emotional gain from giving in older adults: Age-related positivity bias in charitable giving. *Frontiers in Psychology*, *7*, 846. doi:10.3389/fpsyg.2016.00846

Chang, P. J., Wray, L., & Lin, Z. (2014). Social relationships, leisure activity, and health in older adults. *Health Psychology*, *33*(6), 516–523. doi:10.1037/hea0000051

Dave, D., Rashad, I., & Spasojevic, J. (2008). The effects of retirement on physical and mental health outcomes. *Southern Economic Journal*, *75*, 497–523. doi:10.3386/w12123

Earl, J. K., Gerrans, P., & Halim, V. A. (2015). Active and adjusted: Investigating the contribution of leisure, health and psychosocial factors to retirement adjustment. *Leisure Sciences*, *37*(4), 354–372. doi:10.1080/01490400.2015.1021881

Ebbinghaus, B., & Neugschwender, J. (2011). The public-private pension mix and old age income inequality in Europe. In Ebbinghaus, B. (Ed.). *The varieties of pension governance: Pension privatization in Europe* (pp. 384–422). Oxford: Oxford University Press.

Fleiss, J. L. (1971). Measuring nominal scale agreement among many raters. *Psychological Bulletin*, *76*(5), 378–382.

Fratiglioni, L., Paillard-Borg, S., & Winblad, B. (2004). An active and socially integrated lifestyle in late life might protect against dementia. *The Lancet Neurology*, *3*(6), 343–353. doi:10.1016/S1474-4422(04)00767-7

Glass, T. A., Mendes de Leon, C. F., Bassuk, S. S., & Berkman, L. F. (2006). Social engagement and depressive symptoms in late life: Longitudinal findings. *Journal of Aging and Health*, *18*(4), 604–628.

Godfrey, A., Lord, S., Galna, B., Mathers, J. C., Burn, D. J., & Rochester, L. (2006). The association between retirement and age on physical activity in older adults. *Age & Ageing*, *43*, 386–393. doi:10.1093/ageing/aft168

Gow, A. J., Pattie, A., & Deary, I. J. (2017). Lifecourse activity participation from early, mid, and later adulthood as determinants of cognitive aging: The Lothian Birth Cohort 1921. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *72*(1), 25–37.

Grimm, K. J. (2007). Multivariate longitudinal methods for studying developmental relationships between depression and academic achievement. *International Journal of Behavioral Development*, *31*(4), 328–339. doi:10.1177/0165025407077754.

Gudmundsson, P., Lindwall, M., Gustafson, D. R., Östling, S., Hällström, R., Waern, M., & Skoog, I. (2015). Longitudinal associations between physical activity and depression scores in Swedish women followed 32 years. *Acta Psychiatrica Scandinavica*, *132*(6), 451–458. doi:10.1111/acps.12419

Hansson, I., Buratti, S., Thorvaldsson, V., Johansson, B., & Berg, A. I. (2017). Changes in life satisfaction in the retirement transition: Interaction effects of transition type and individual resources. *Work, Aging & Retirement*, *4*, 352–366, doi:10.1093/workar/wax025

Harris, A. H. S., Cronkite, R., & Moos, R. (2006). Physical activity, exercise coping, and depression in a 10-year cohort study of depressed patients. *Journal of Affective Disorders*, *93*(1–3), 79–85.

Heaney, J. L. J., Carroll, D., & Phillips, A. C. (2014). Physical activity, life events stress, cortisol, and DHEA: Preliminary findings that physical activity may buffer against the negative effects of stress. *Journal of Aging and Physical Activity*, *22*(4), 465–473. doi:10.1123/JAPA.2012-0082

Henning, G., Lindwall, M., & Johansson, B. (2016). Continuity in Well-Being in the Transition to Retirement. *GeroPsych*, *29*(4), 225–237. doi:10.1024/1662-9647/a000155.

Henning, G., Bjälkebring, P., Stenling, A., Thorvaldsson, V., Johansson, B., & Lindwall, M. (2019). Changes in within- and between-person associations between basic psychological need satisfaction and well-being after retirement. *Journal of Research in Personality*, *79*, 151–160.

Henning, G., Stenling, A., Tafvelin, S., Hansson, I., Kivi, M., Johansson, B., & Lindwall, M. (2019). Pre-retirement work motivation and subsequent retirement adjustment – a self-determination theory perspective. *Work, Aging & Retirement*, *5*, 189–203. doi:10.1093/workar/way017

Hong, S.-I., Hasche, L., & Bowland, S. (2009). Structural. relationships between social activities and longitudinal trajectories of depression among older adults. *The Gerontologist*, *49*(1), 1–11.

Huxhold, O., Fiori, K. L., & Windsor, T. D. (2013). The dynamic interplay of social network characteristics, subjective well-being, and health: The costs and benefits of socio-emotional selectivity. *Psychology and Aging*, *28*(1), 3–16. doi:10.1037/a0030170

Iso-Ahola, S. E., & Park, C. J. (1996). Leisure-related social support and self-determination as buffers of stress-illness relationship. *Journal of Leisure Research*, *28*(3), 169–187. doi:10.1080/00222216.1996.11949769

Janke, M., Davey, A., & Kleiber, D. (2006). Modeling change in older adults' leisure activities. *Leisure Sciences*, *28*(3), 285–303.

Janke, M. C., Nimrod, G., & Kleiber, D. A. (2008). Reduction in leisure activity and well-being during the transition to widowhood. *Journal of Women & Aging*, *20*, 83–98. doi:10.1300/J074v20n01_07

Kim, J. E., & Moen, P. (2002). Retirement transitions, gender, and psychological well-being: A life-course, ecological model. *The Journals of Gerontology: Series B*, *57*, 212–222. doi:10.1093/geronb/57.3.P212

Köhncke, Y., Laukka, E. J., Brehmer, Y., Kalpouzos, G., Li, T.-Q., Fratiglioni, L., … Lövdén, M. (2016). Three-year changes in leisure activities are associated with concurrent changes in white matter microstructure and perceptual speed in individuals aged 80 years and older. *Neurobiology of Aging*, *41*, 173–186. doi:10.1016/j.neurobiolaging.2016.02.01

Kuykendall, L., Boemerman, L., & Zhu, Z. (2018). The importance of leisure for subjective well-being. In E. Diener, S. Oishi, & L. Tay (Eds.), *Handbook of well-being*. Salt Lake City, UT: DEF Publishers.

Kuykendall, L., Tay, L., & Ng, V. (2015). Leisure engagement and subjective well-being: A meta-analysis. *Psychological Bulletin*, *141*(2), 364–403.

Lahti, J., Laaksonen, M., Lahelma, E., & Rahkonen, O. (2011). Changes in leisure-time physical activity after transition to retirement: A follow-up study. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 36. 36 doi:10.1186/1479-5868-8-

Lam, L. C. W., Ong, P. A., Dikot, Y., Sofiatin, Y., Wang, H., Zhao, M., … Lai, K. (2015). Intellectual and physical activities, but not social activities, are associated with better global cognition: A multi-site evaluation of the cognition and lifestyle activity study for seniors in Asia (CLASSA.). *Age and Ageing*, *44*(5), 835–840.

Lampinen, P., Heikkinen, R.-L., Kauppinen, M., & Heikkinen, E. (2006). Activity as a predictor of mental well-being among older adults. *Aging & Mental Health*, *10*, 454–466. doi:10.1080/13607860600640962

Lee, Y., Chi, I., & Palinkas, L. A. (2019). Retirement, leisure activity engagement, and cognition among older adults in the United States. *Journal of Aging and Health*, *31*(7), 1212–1234. doi:10.1177/0898264318767030

Lindwall, M., Berg, A. I., Bjälkebring, P., Buratti, S., Hansson, I., Hassing, L., … Johansson, B. (2017). Psychological health in the retirement transition: Rationale and first findings in the HEalth, Aging and Retirement Transitions in Sweden (HEARTS) study. *Frontiers in Psychology*, *8*, 1634.

Lindwall, M., Larsman, P., & Hagger, M. S. (2011). The reciprocal relationship between physical activity and depression in older European adults: A prospective cross- lagged panel design using SHARE data. *Health Psychology*, *30*(4), 453–462. doi:10.1037/a0023268
Marsh, H. W. (2007). Application of confirmatory factor analysis and structural equation modeling in sport and exercise psychology. In G. Tenenbaum, & R. C. Eklund (Eds.). *Handbook of sport psychology* (3rd ed., pp. 774–798). Hoboken, NJ: Wiley.
Marsh, H. W., Lüdtke, O., Muthén, B., Asparouhov, T., Morin, A. J. S., Trautwein, U., & Nagengast, B. (2010). A new look at the big five factor structure through exploratory structural equation modeling. *Psychological Assessment*, *22*(3), 471–491.
McArdle, J. J. (2009). Latent variable modeling of differences in changes with longitudinal data. *Annual Review of Psychology*, *60*(1), 577–605.
McArdle, J. J., & Grimm, K. J. (2010). Five steps in latent curve and latent change score modelling with longitudinal data. In K. van Montfort, J. Oud, & A. Satorra (Eds.), *Longitudinal research with latent variables* (pp. 245–274). Heidelberg, Germany: Springer-Verlag.
McArdle, J. J., & Hamagami, F. (2001). Latent difference score structural models for linear dynamic analyses with incomplete longitudinal data. In L. M. Collins & A. G. Sayer (Eds.), *Decade of behavior. New methods for the analysis of change* (pp. 139–175). Washington, DC, US: American Psychological Association.
Menec, V. H. (2003). The Relation Between Everyday Activities and Successful Aging: A 6-Year Longitudinal Study. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *58*(2), S74–S82. doi:10.1093/geronb/58.2.S74.
Min, J., Ailshire, J., & Crimmins, E. M. (2016). Social engagement and depressive symptoms: Do baseline depression status and type of social activities make a difference? *Age and Ageing*, *45*(6), 838–843.
Muthén, B. O., & Muthén, L. K. (1998–2015). *Mplus user's guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.
Netz, Z., Wu, M. J., Becker, B. J., & Tenenbaum, G. (2005). Physical activity and psychological well-being in advanced age: A meta-analysis of intervention studies. *Psychology and Aging*, *20*, 272–284. doi:10.1037/0882-7974.20.2.272
Nimrod, G. (2007). Expanding, reducing, concentrating and diffusing: Post retirement leisure behavior and life satisfaction. *Leisure Sciences*, *29*(1), 91–111. doi:10.1080/01490400600983446
Nimrod, G., & Janke, M. (2012). Leisure across the later lifespan. In H. J. Gibson & J.F. Singleton (Eds.), *Leisure and aging: Theory and practice* (pp. 95–109). Champaign: Human Kinetics.
Nimrod, G., Janke, M. C., & Kleiber, D. A. (2008). Expanding, reducing, concentrating and diffusing: Activity patterns of recent retirees in the United States. *Leisure Sciences*, *31*(1), 37–52. doi:10.1080/01490400802558087
Nimrod, G., & Shrira, A. (2016). The paradox of leisure in later life. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *71*(1), 106–111.
Paul, K. I., & Batinic, B. (2010). The need for work: Jahoda's latent functions of employment in a representative sample of the German population. *Journal of Organizational Behavior*, *31*(1), 45–64.
Penedo, F., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry*, *18*(2), 189–193. doi:10.1097/00001504-200503000-00013
Roberts, K. (1999). *Leisure in contemporary society*. Wallingford, UK: CAB International.
Rosenkoetter, M. M., Gams, J. M., & Engdahl, R. A. (2001). Postretirement use of time. *Activities, Adaptation & Aging*, *25*, 1–18. doi:10.1300/J016v25n03_01
Rowe, J. W., & Kahn, R. L. (1997). *Successful aging. The Gerontologist*, *37*(4), 433–440. doi:10.1093/geront/37.4.433
Ryser, V.-A., & Wernli, B. (2017). How does transitioning into retirement impact the individual emotional system? Evidence from the Swiss context. *Advances in Life Course Research*, *32*, 42–54.
Scherger, S., Nazroo, J., & Higgs, P. (2011). Leisure activities and retirement: Do structures of inequality change in old age?. *Ageing and Society*, *31*(1), 146–172. doi:10.1017/S0144686X10000577
Schöllgen, I., Huxhold, O., & Schmiedek, F. (2012). Emotions and physical health in the second half of life: Interindividual differences in age-related trajectories and dynamic associations according to socioeconomic status. *Psychology and Aging*, *27*(2), 338–352. doi:10.1037/a0026115
Silverstein, M., & Parker, M. G. (2002). Leisure activities and quality of life among the oldest old in Sweden. *Research on Aging*, *24*(5), 528–547. doi:10.1177/0164027502245003
Slingerland, A. S., van Lenthe, F. J., Jukema, J. W., Kamphuis, C. B. M., Looman, C., Giskes, K., … Brug, J. (2007). Aging, retirement, and changes in physical activity: Prospective cohort findings from the GLOBE study. *American Journal of Epidemiology*, *165*(12), 1356–1363. doi:10.1093/aje/kwm053
Sposito, G., Neri, A. L., & Yassuda, M. S. (2015). Cognitive performance and engagement in physical, social and intellectual activities in older adults: The FIBRA study. *Dementia & Neuropsychologia*, *9*, 270–278. doi:10.1590/1980-57642015dn93000010
Sprod, J., Olds, T., Brown, W., Burton, N., van Uffelen, J., Ferrar, K., & Maher, C. (2017). Changes in use of time across retirement: A longitudinal study. *Maturitas*, *100*, 70–76. doi:10.1016/j.maturitas.2017.02.018
Strain, L. A., Grabusic, C. C., Searle, M. S., & Dunn, N. J. (2002). Continuing and ceasing leisure activities in later life: A longitudinal study. *The Gerontologist*, *42*(2), 217–223. doi:10.1093/geront/42.2.217
Van de Velde, S., Levecque, K., & Bracke, P. (2009). Measurement equivalence of the CES- D 8 in the general population in Belgium: A gender perspective. *Archives of Public Health*, *67*(1), 15–29.
Van Solinge, H., & Henkens, K. (2005). Couples' adjustment to retirement: A multi-actor panel study. *The Journals of Gerontology: Series B*, *60*, 11–20. doi:10.1093/geronb/60.1.S11
Van Solinge, H., & Henkens, K. (2008). Adjustment to and satisfaction with retirement: Two of a kind?. *Psychology and Aging*, *23*(2), 422–434. doi:10.1037/0882-7974.23.2.422
Wang, M., Henkens, K., & van Solinge, H. (2011). Retirement adjustment: A review of theoretical and empirical advancements. *American Psychologist*, *66*(3), 204–1009. doi:10.1037/a0022414
Wang, H.-X., Xu, W., & Pei, J.-J. (2012). Leisure activities, cognition and dementia. *Biochimica et Biophysica Acta (BBA) - Molecular Basis of Disease*, *1822*(3), 482–491. doi: 10.1016/j.bbadis.2011.09.002
Westerlund, H., Vahtera, J., Ferrie, J. E., Singh-Manoux, A., Pentti, J., Melchior, M., … Kivimaki, M. (2010). Effect of retirement on major chronic conditions and fatigue: French GAZEL occupational cohort study. *BMJ*, *341*, c6149. doi:10.1136/bmj.c6149
Wetzel, M., Bowen, C. E., & Huxhold, O. (2019). Level and change in economic, social, and personal resources for people retiring from paid work and other labour market statuses. *European Journal of Aging*, *16*, 439–453. doi:10.1007/s10433-019-00516-y
Wetzel, M., & Huxhold, O. (2016). Are leisure activity and health interconnected after retirement: Educational differences. *Advances in Life Course Research*, *30*, 43–52. doi:10.1016/j.alcr.2016.03.007
Wetzel, M., Huxhold, O., & Tesch-Römer, C. (2016). Transition into retirement affects life satisfaction: Short- and long-term development depends on last labor market status and education. *Social Indicators Research*, *125*(3), 991–1009. 015-0862-4 doi:10.1007/s11205-
Yeung, D. Y. (2013). Is pre-retirement planning always good? An exploratory study of retirement adjustment among Hong Kong Chinese retirees. *Aging & Mental Health*, *17*, 386–393. doi:10.1080/13607863.2012.732036

Appendix A. Coding leisure activities

Instructions

Please rate the following leisure activities as predominantly physical, social, or intellectual. If an activity may match more than one category, please choose the one that fits best. See below the descriptions.

Predominantly physical (p) – activities that mainly involve physical activity. The WHO describes physical activity as 'any bodily movement produced by skeletal muscles that requires energy expenditure'. This may include sports or activities were you need to move around a lot.

Predominantly social (s) – activities that mainly involve social exchange and activity with others, such as doing things together with a friend or partner or doing things in a group.

Predominantly intellectual (i) – activities done mostly by oneself for mental stimulation.

Ratings		Rater				
Swedish text	English translation	1. Type	2. Type	3. Type	4. Type	5. Type
Trädgårdarbete (inklusive underhållsarbete och snöskottning)	Gardening (including maintenance work and snow shoveling)	P	P	P	P	P
Utomhusaktiviteter (t ex fiske, jakt, plocka bär/svamp)	Outdoor activities (e.g. fishing, hunting, search for mushrooms)	P	P	P	P	P
Kulturella aktiviteter (t ex gå på bio, teater, konserter, museum, utställningar)	Cultural activities (e.g. going to the movies,theatre, concerts, museum, exhibitions …)	S	S	S	I	I
Deltar i religiösa aktiviteter	Participating in religious activities	S	S	S	X	S
Äta ute (på restaurant eller liknande)	Eating out (in a restaurant etc.)	S	S	S	S	S
Läsa böcker	Reading books	I	I	I	I	I
Läsa tidningar	Reading newspapers	I	I	I	I	I
Spela spel (t ex kortspel, bridge, bingo, brädspel)	Playing games (e.g. cards, bridge, bingo, boardgames)	S	X	I	S	I
Använda dator (t ex surfa på internet, skriva, spela spel)	Using the computer (e.g. surfing the internet, writing, playing games)	I	X	I	I	I
Löser korsord/sudoko eller liknande	Solving cross word puzzles/sudoku	I	I	I	I	I
Besöker släktingar	Visiting relatives	S	S	S	S	S
Har släktingar som kommer på besök	Having relatives visiting me	S	S	S	S	S
Hälsar på vänner/bekanta	Meeting friends/acquaintances	S	S	S	S	S
Har vänner/bekanta som kommer på besök	Having friends/acquaintances visiting me	S	S	S	S	S
Deltar i studiecirklar	Participating in evening classes/ study groups	S	I	S	S	I
Hobbyaktiviteter (t ex virka, sy, snickra, måla, samla frimärken mm)	Hobbies (e.g. crochet, sewing, carpentry, painting, collecting stamps etc.)	I	I	I	X	X
Promenader/stavgång	Going for a walk / nordic walking	P	P	P	P	P
Dansa	Dancing	P	P	P	P	P
Golf	Playing golf	P	P	P	P	P
Boule, bangolf eller liknande	Boule, minigolf etc.	S	X	P	P	P
Bollsport (t ex tennis, fotboll eller liknande)	Ball games (e.g. tennis, soccer)	P	P	P	P	P
Motion/träning (t ex jogging,gymnastik, styrketräning, Friskis & Svettis eller liknande)	Exercise (e.g. jogging, gymnastics, strength training)	P	P	P	P	P
Titta på idrott/vara åskådare på plats (dvs inte på TV)	Watching sport games (not on the TV)	S	X	S	X	X

Note. P = predominantly physical activity, S = predominantly social activity, I = predominantly intellectual activity, X = no category applies / miscellaneous.

Appendix B. Effects of covariates

	Model Intellectual Activity		Model Social Activity		Model Physical Activity	
	Depressive symptoms	Intellectual activity	Depressive symptoms	Social activity	Depressive symptoms	Physical activity
Age ➔ level	0.00 (0.01)	0.10 (0.07)	0.00 (0.01)	−0.01 (0.07)	0.00 (0.01)	−0.09 (0.08)
Gender ➔ level	0.02 (0.02)	1.91 (0.21)***	0.02 (0.02)	0.98 (0.21)***	0.02 (0.02)	0.61 (0.24)*
Education ➔ level	0.05 (0.02)*	0.62 (0.21)**	0.05 (0.02)*	0.58 (0.21)**	0.05 (0.02)	0.47 (0.24)
Disease load ➔ level	0.03 (0.00)***	−0.06 (0.04)	0.03 (0.00)***	−0.12 (0.04)**	0.03 (0.00)***	−0.29 (0.05)***
Control ➔ level	−0.03 (0.01)*	0.18 (0.11)	−0.03 (0.01)*	0.05 (0.11)	−0.03 (0.01)**	0.25 (0.12)*
Financial resources ➔ level	−0.04 (0.05)	2.10 (0.44)***	−0.03 (0.05)	0.70 (0.45)	−0.04 (0.05)	1.52 (0.50)**
Post-retirement work ➔ level	0.01 (0.03)	0.10 (0.24)	0.01 (0.03)	1.02 (0.24)***	0.01 (0.03)	0.16 (0.27)
Age ➔ slope	0.01 (0.01)	0.06 (0.04)	0.01 (0.01)	0.05 (0.05)	0.01 (0.01)	−0.04 (0.06)
Gender ➔ slope	0.03 (0.02)	1.11 (0.27)***	0.03 (0.03)	0.95 (0.19)***	0.03 (0.03)	0.14 (0.20)
Education ➔ slope	0.04 (0.03)	0.42 (0.15)**	0.03 (0.03)	0.61 (0.16)***	0.04 (0.03)	0.55 (0.20)**
Disease Load ➔ slope	0.04 (0.01)***	−0.01 (0.02)	0.04 (0.01)***	−0.05 (0.03)	0.05 (0.01)***	−0.18 (0.04)***
Control ➔ slope	−0.07 (0.01)***	0.14 (0.07)**	−0.06 (0.01)***	0.11 (0.08)	−0.07 (0.02)***	0.45 (0.10)***
Financial resources ➔ slope	−0.16 (0.05)**	0.80 (0.35)	−0.16 (0.05)**	0.39 (0.32)	−0.15 (0.06)**	1.69 (0.43)***
Post-retirement work ➔ slope	−0.01 (0.03)	−0.20 (0.13)	-0.01 (0.03)	0.36 (0.18)*	0.00 (0.03)	−0.36 (0.22)